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Figure 1a Phase Plot Showing Coma Aberration

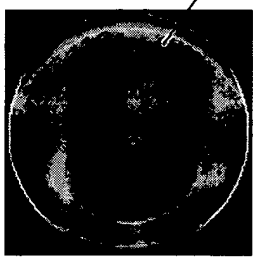


Figure 1b Pin Hole Image in the Presence of Coma

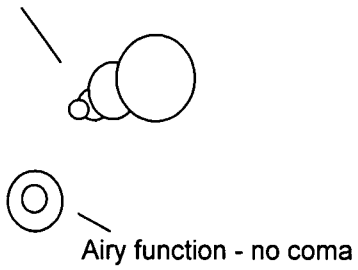


Figure 1c Lens Distortion - Coma and Tilt Contributions - Where, Vectors Represent Overlay Error

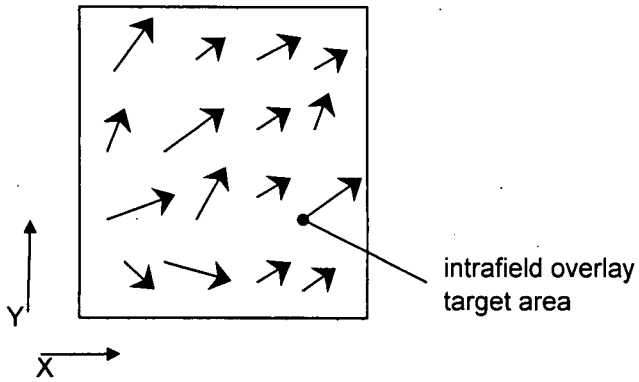


Figure 1d Shifting Effects of x-coma on Vertical, Large Feature Patterns

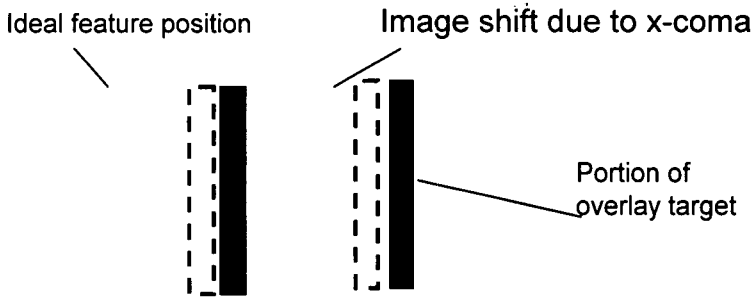


Figure 1e Lens Distortion - Coma Effects Removed

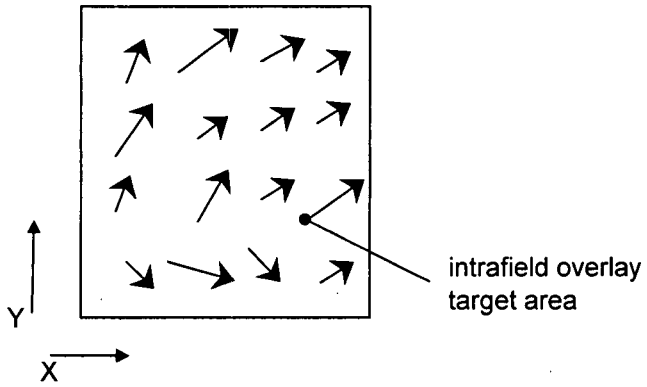


Figure 2a Typical Overlay Patterns or Completed Alignment Attributes

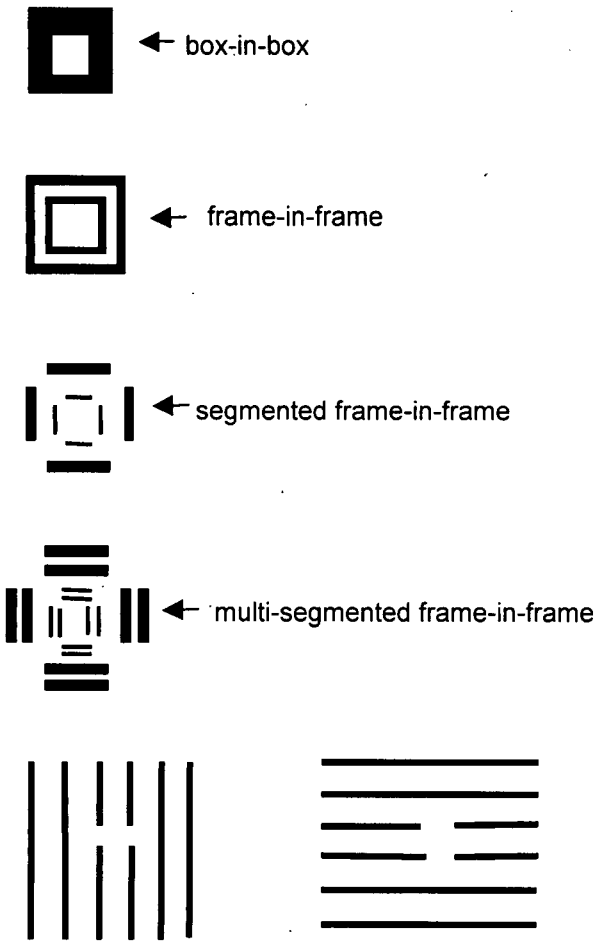


Figure 2b Typical Overlay Coordinate System with Vector Off-set for Segmented Overlay Target

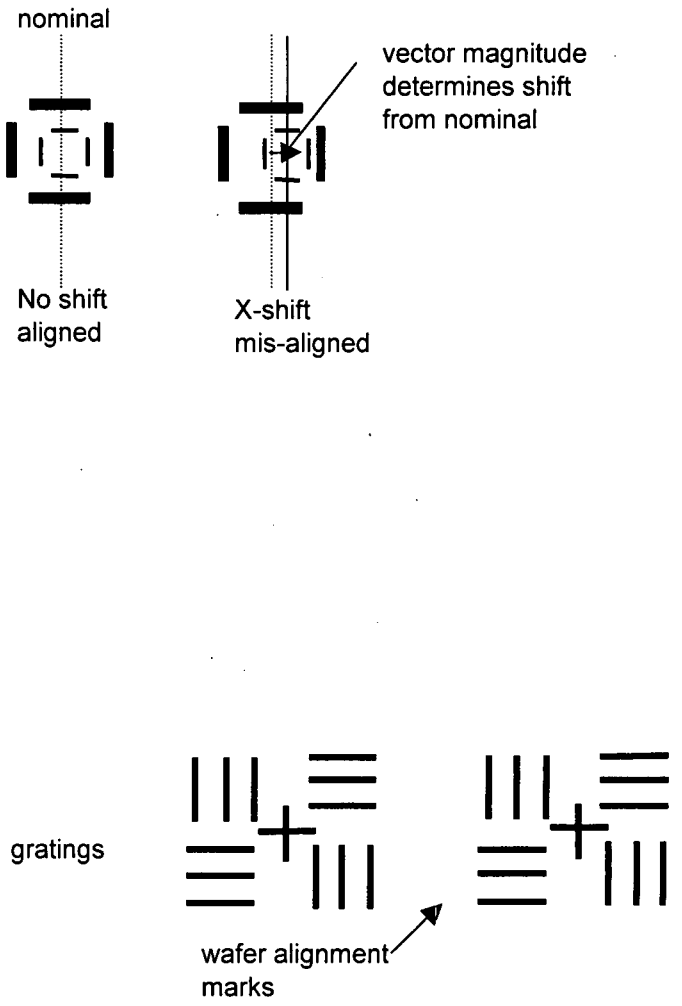
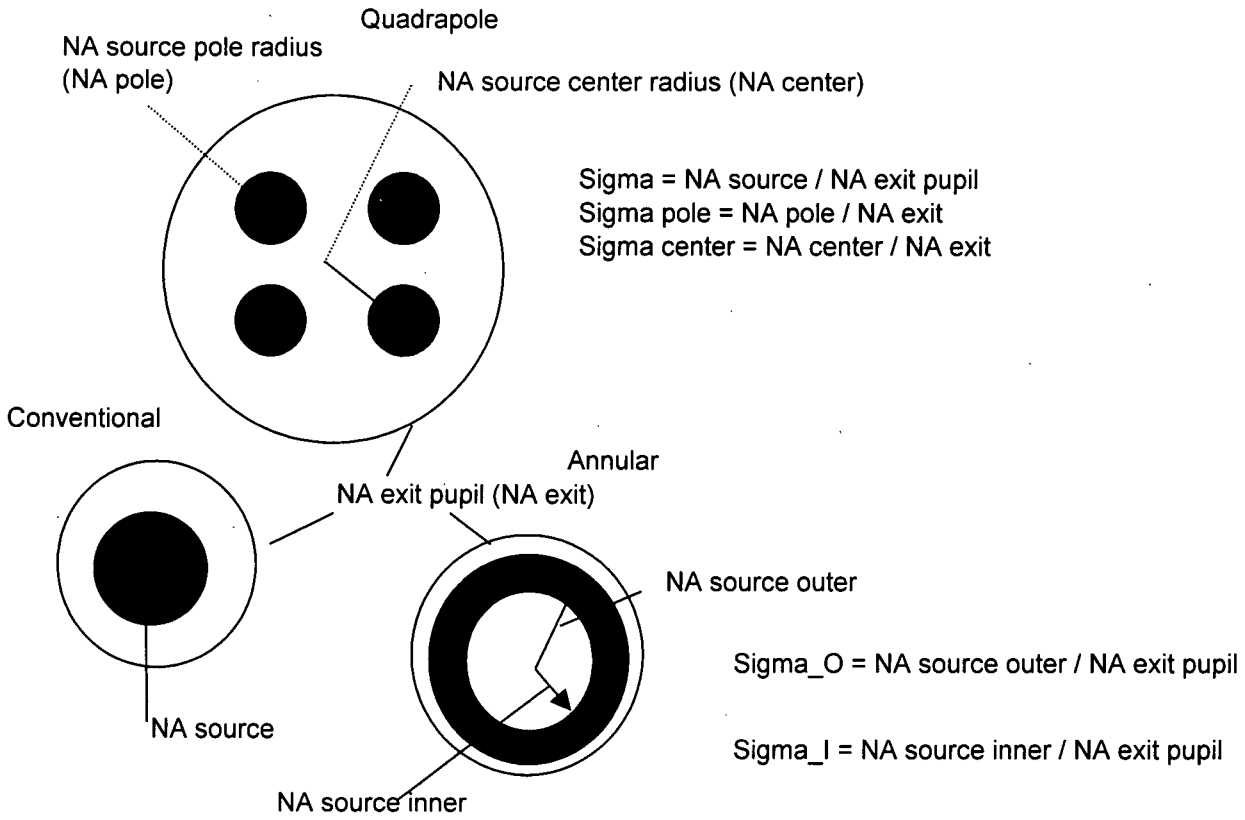


Figure 3 Quadrapole, Annular, and Conventional Coordinate Definitions



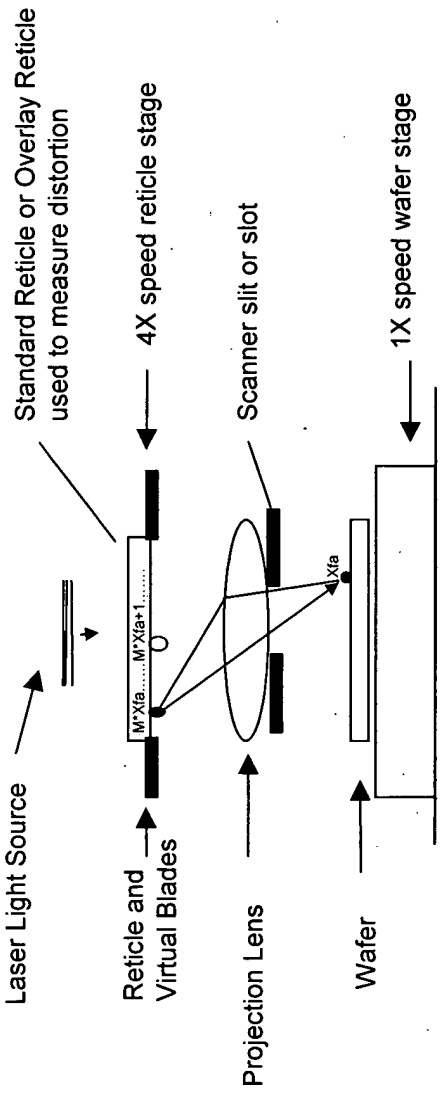


Figure 4a Photolithographic Scanner System

Figure 4b Scanner Field and Scanner Slot / Slit Coordinate System

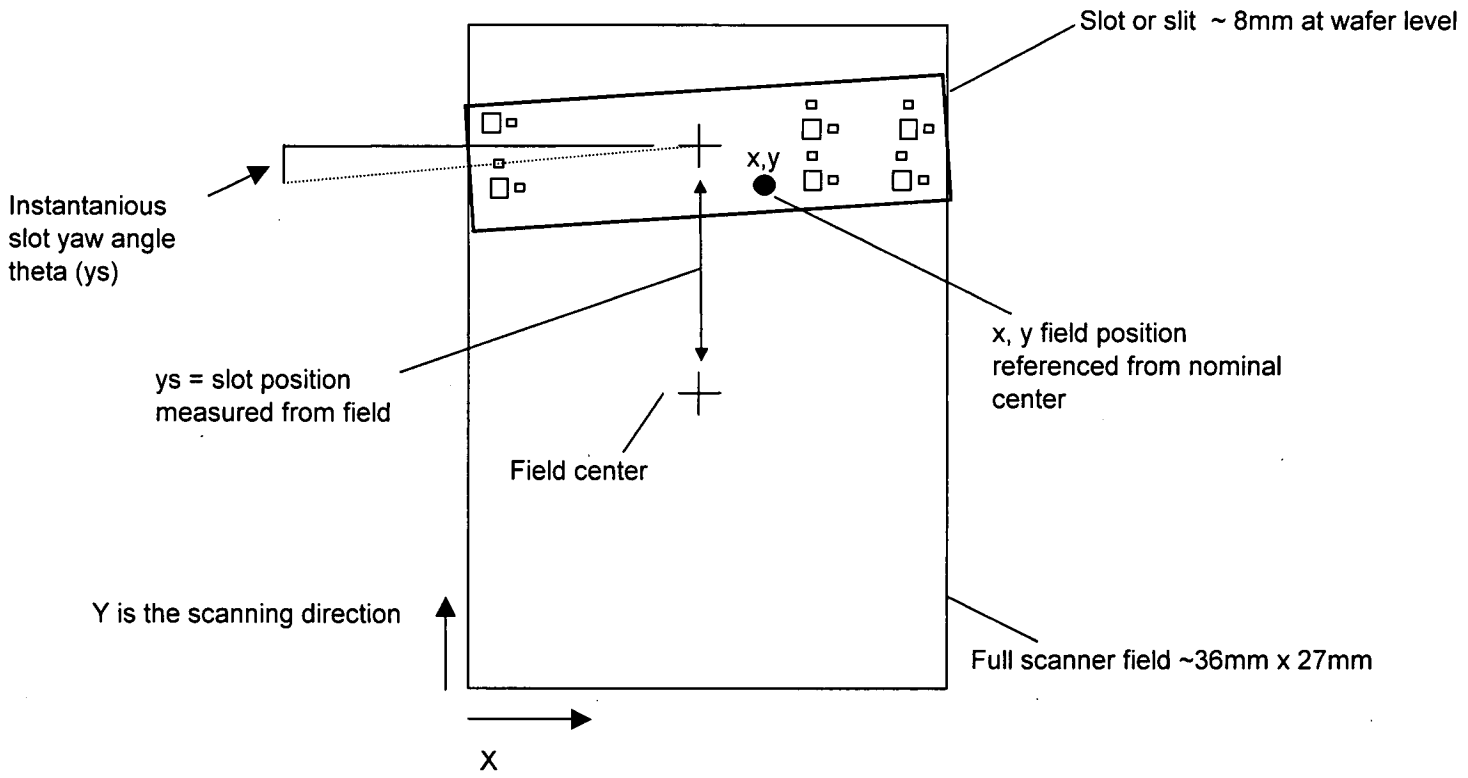
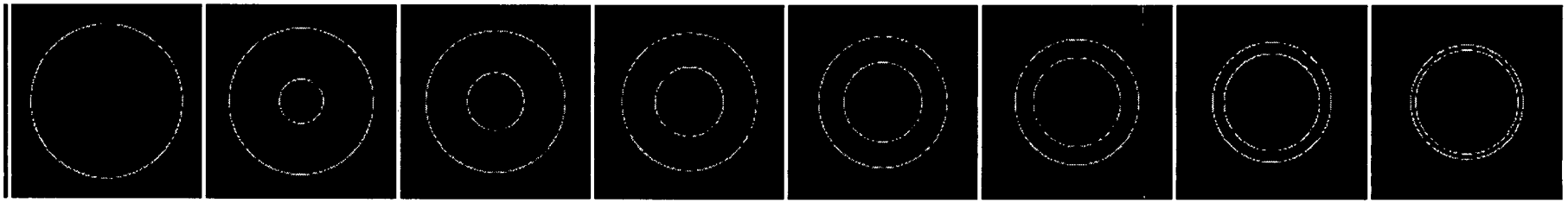


Figure 5a Sample Sources Showing Zero Coma Sensitivity (dX / da8 = dY / da7 = 0) to Large Feature Shfit for 248nm and NA =0.6

1um space/4um pitch
400nm resist Threshold model,
E/Eo = 3, focus =150nm

SOURCE SHAPES IN GENERALLY ACCESSIBLE OR 'PRACTICAL' REGION. PRACTICAL REGION IS SIGMA_O < 0.8 AND 0.25 < EPS < 0.75

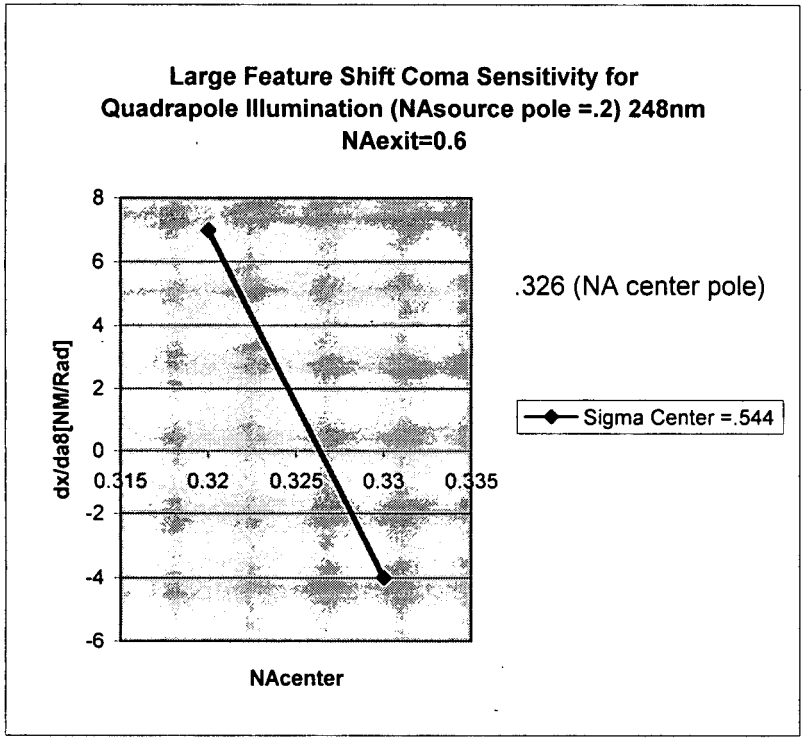
NA = 0.60, LAMBDA = 248NM



SIGMA_O	0.836	0.797	0.772	0.746	0.714	0.684	0.653	0.621
SIGMA_I	0	0.239	0.309	0.373	0.428	0.479	0.522	0.559
EPS	0	0.3	0.4	0.5	0.6	0.7	0.8	0.9

EPS = fractional size of hole in source = SIGMA_I / SIGMA_0

Figure 5b Large Feature Coma Sensitivity for Quadrapole NA=0.6 Sigma Pole Radius =.333



1um space/4um pitch
400nm resist, resist threshold model,
E/E0 = 3, focus = 150nm into resist

Figure 6a Qudrapole Source Shapes Optimized to Reduce the Effects of Coma for Various Wavelengths NA Exit Pupil = 0.6 for a 1um Space/4um Pitch Feature 400nm Resist, Resist Threshold Model, E/E0 = 3, Focus = 150nm

Wavelength	NA exit	NA pole	NA center	Sigma Pole	Sigma Center
365nm	0.6	0.2	0.3270	0.3333	0.5450
248nm	0.6	0.2	0.3263	0.3333	0.5438
193nm	0.6	0.2	0.3232	0.3333	0.5387
157nm	0.6	0.2	0.3189	0.3333	0.5315

Figure 6b Qudrapole Source Shapes optimized to reduce the effects of coma for various wavelengths NA exit pupil = 0.9 for a 1um space/4um pitch 400nm resist, resist threshold model, E/E0 = 3 focus = 150nm

Wavelength	NA exit	NA pole	NA center	Sigma Pole	Sigma Center
365nm	0.9	0.2	0.4995	0.2222	0.5550
248nm	0.9	0.2	0.4818	0.2222	0.5353
193nm	0.9	0.2	0.4725	0.2222	0.5250
157nm	0.9	0.2	0.4719	0.2222	0.5243

Figure 7a Process and Application Flow for the Preferred Embodiment Using Simulation

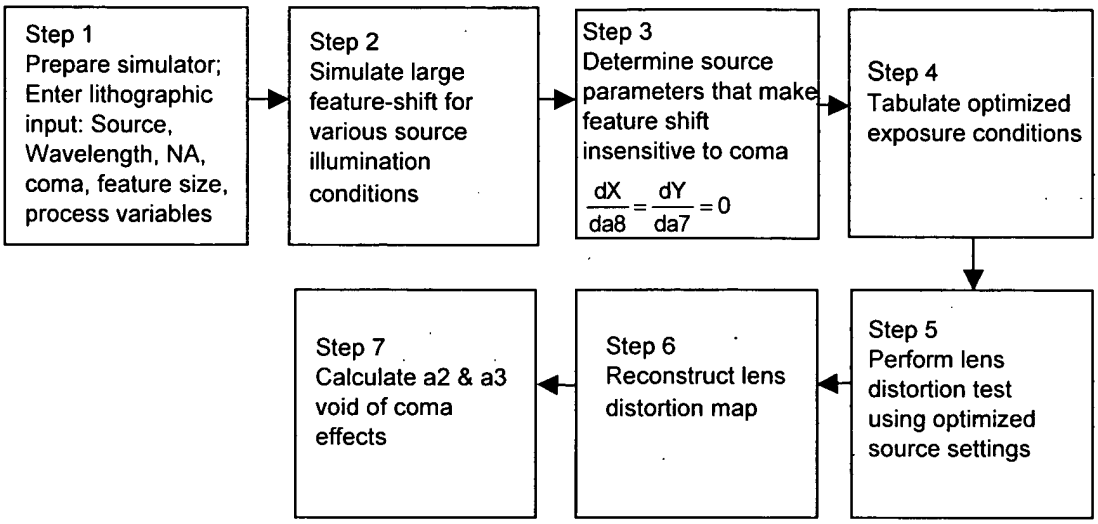


Figure 7b Process Flow for Applying the Preferred Embodiment Using Look-Up Tables

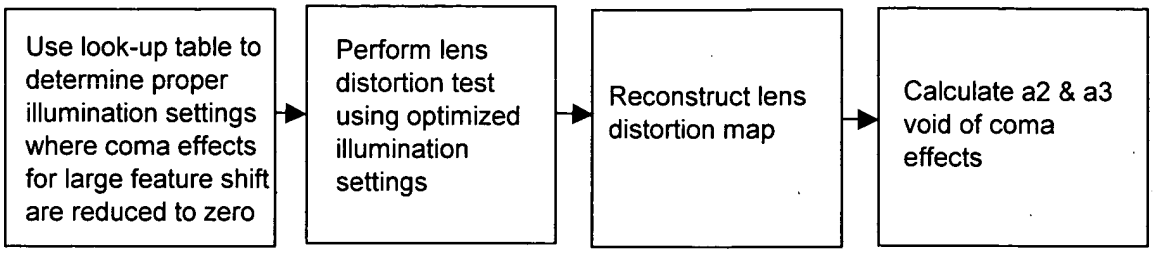
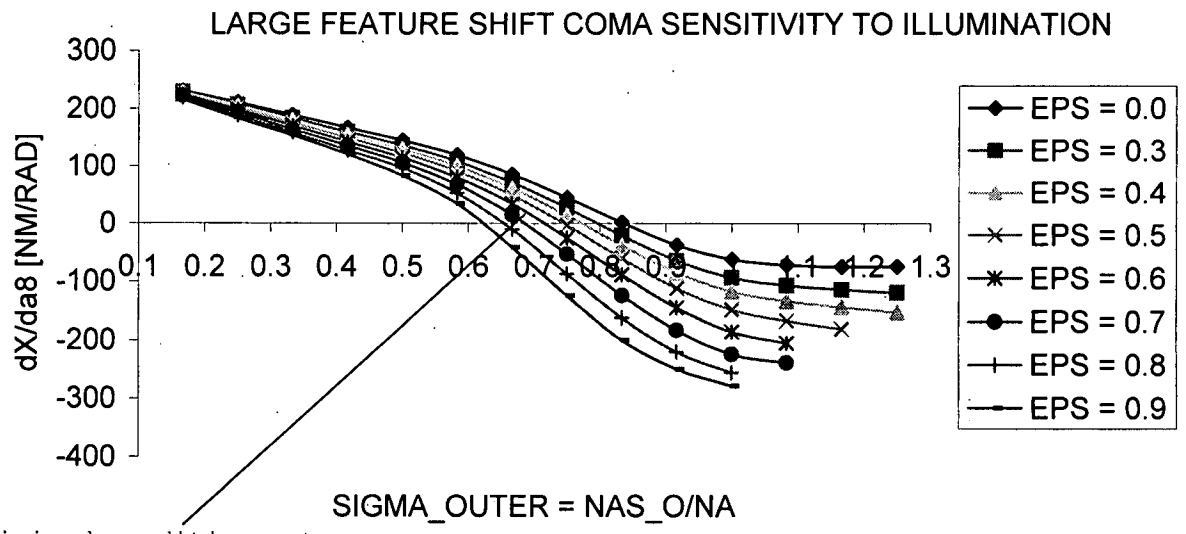


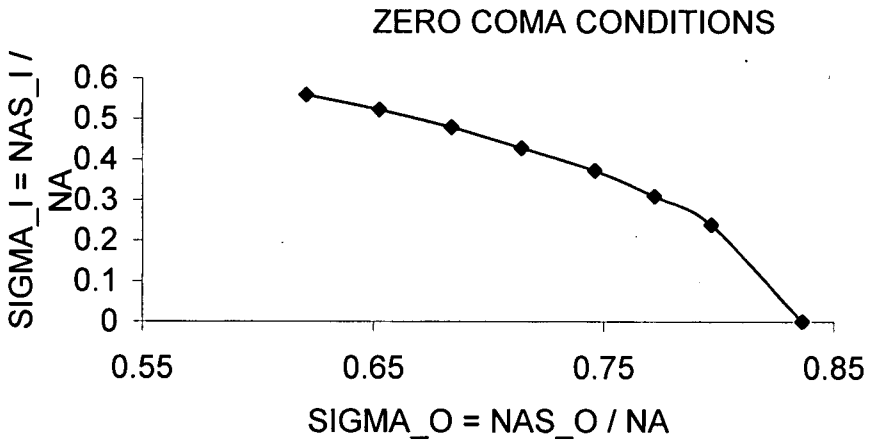
Figure 8a Large Feature Sensitivity Plot Showing Coma Coefficient (dx/da8) Versus Both Sigma Outer and EPS = Sigma Inner / Sigma Outer for NA =0.6 and 248nm Simulations

1um space/4um pitch
400nm resist, resist threshold
model, E/E0 = 3
focus = 150nm



optimized conditions at intersection

Figure 8b 248nm Annular Illumination Optimized Source Settings Showing Sigma Inner vs. Sigma Outer for an NA= 0.6 for a Large Feature



Lithography simulation conditions:
M = magnification = 4,
Threshold resist model E/E0 = 3,
400 NM resist thickness,
focus = 150nm
1um large feature on a 4um pitch

Figure 9a Large Feature Sensitivity Plot Showing Coma Coefficient (dx/da8) Versus Both Sigma Outer and EPS = Sigma Inner / Sigma Outer for NA =0.75 and 193nm Simulations

```
1um space/4um pitch
400nm resist, resist
threshold model, E/E0 = 3,
focus = 150nm
```

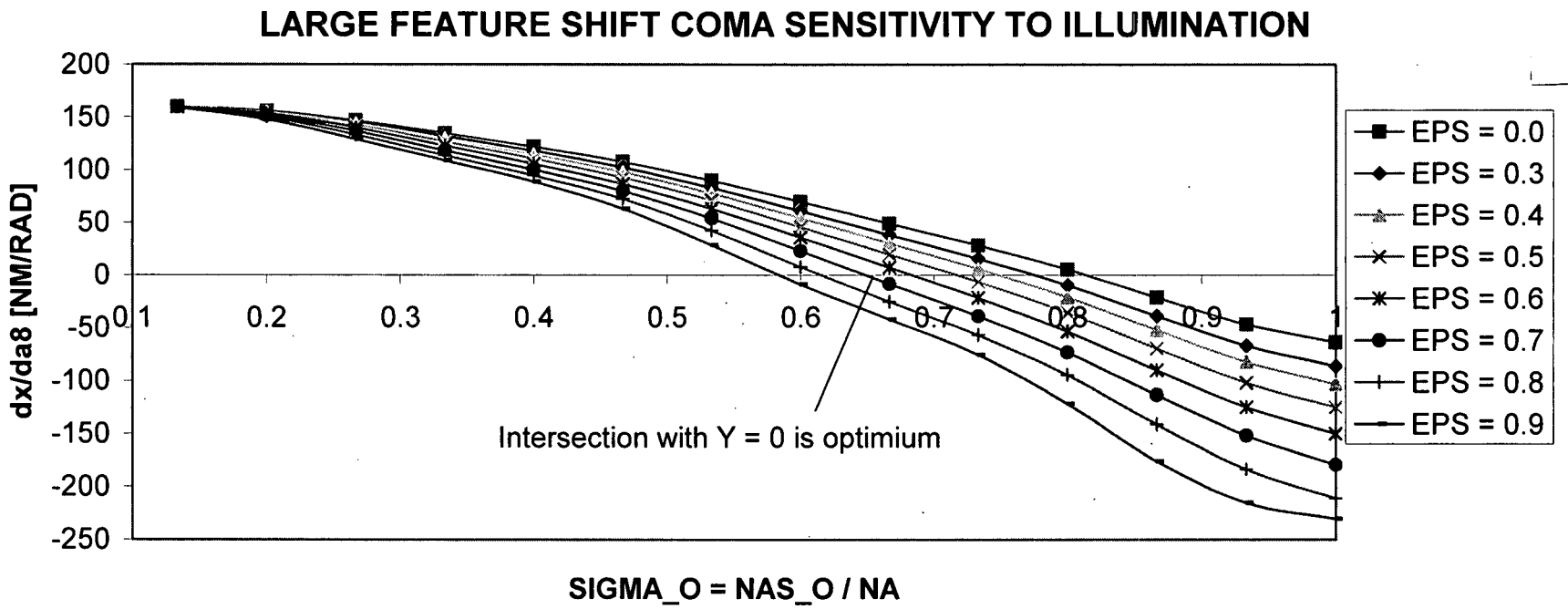
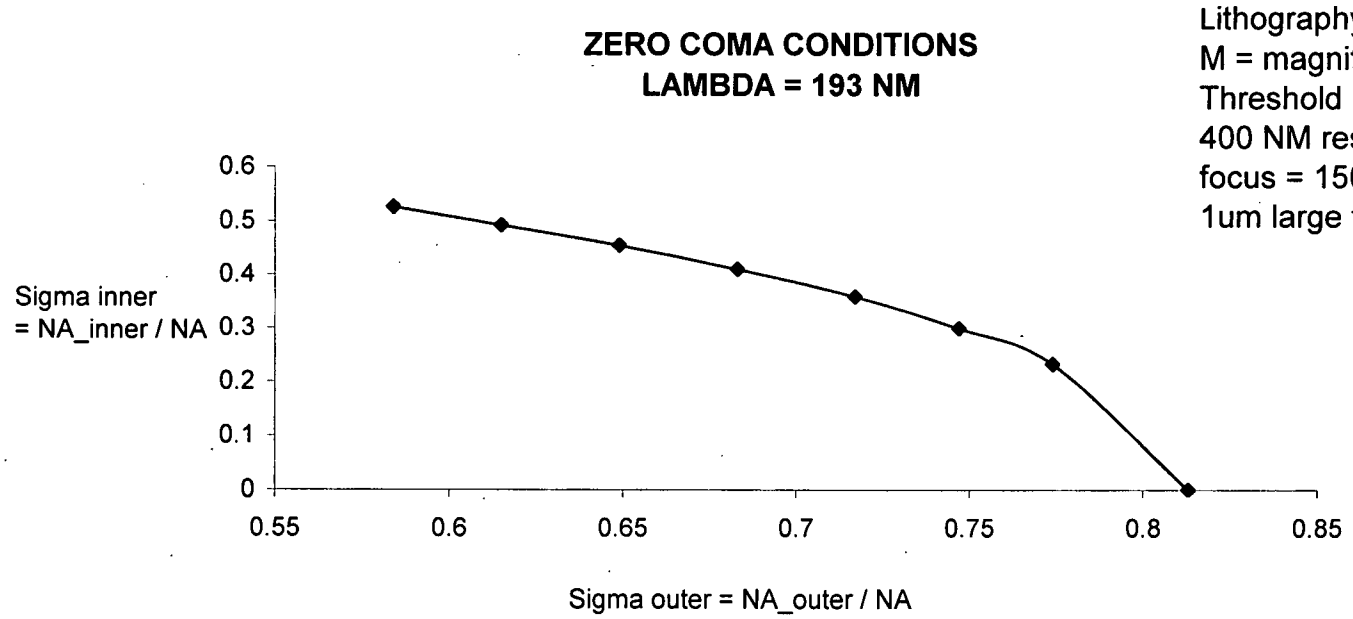


Figure 9b 193nm Annular Illumination Optimized Source Settings
Showing Sigma Inner vs. Sigma Outer for an NA= 0.75 for a Large Feature



Lithography simulation conditions:
M = magnification = 4,
Threshold resist model E/E0 = 3,
400 NM resist thickness,
focus = 150nm
1um large feature on a 4um pitch

Figure 10a Zero Coma Conditions for Different NA / Wavelength Annular Illumination

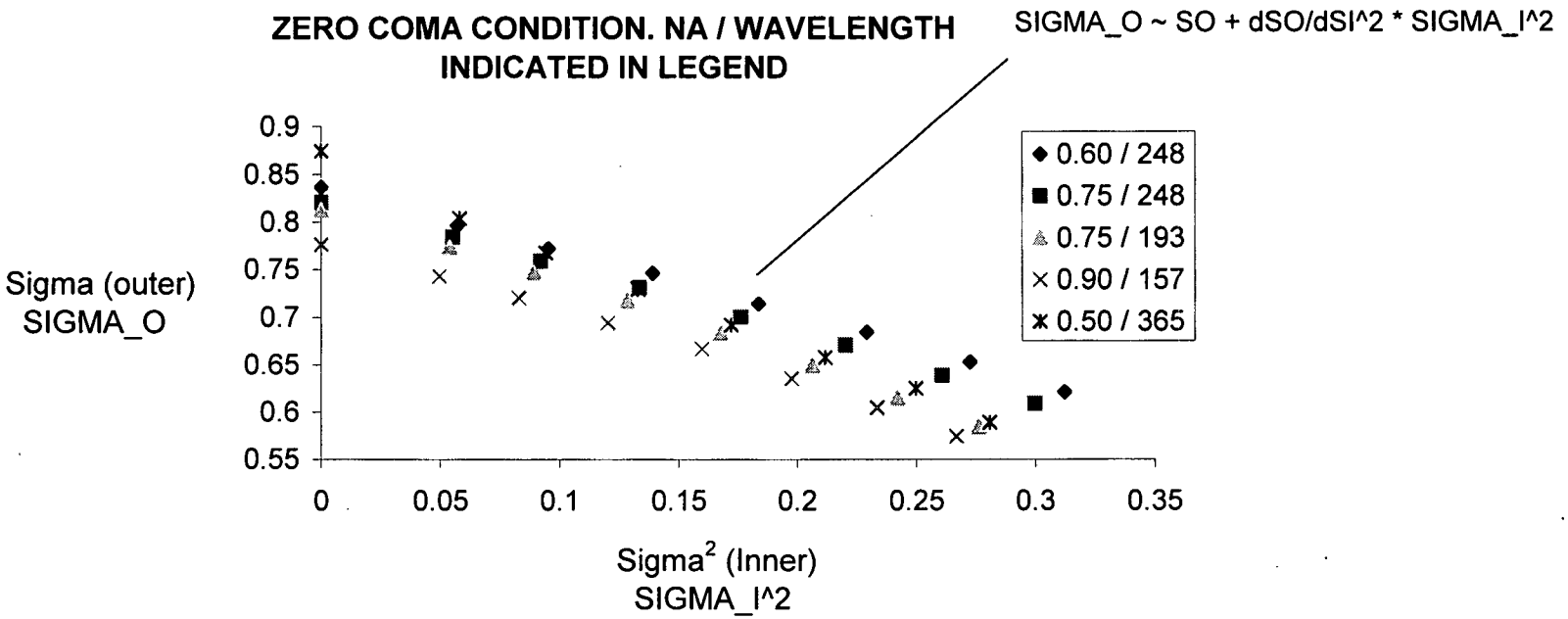


Figure 10b A Plot Showing the Fitting Coefficients for Annular Illumination as a Function of Wavelength / NA

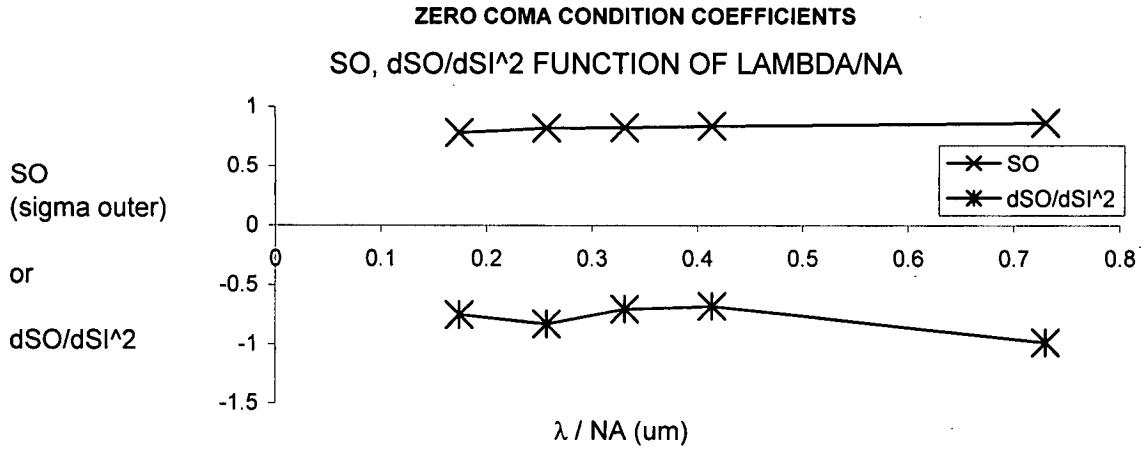


Figure 10c A Table Listing the Fitting Coefficients Exhibiting Zero Coma Conditions for Annular Illumination

FITTING COEFFICIENTS AS FUNCTION OF LAMBDA/NA					
LAMBDA/NA [UM]	LAMBDA	NA	SO	dSO/dSI^2	RSQ
0.73	365	0.5	0.8652	-0.9867	0.9969
0.413966667	248.38	0.6	0.8375	-0.6808	0.9989
0.331173333	248.38	0.75	0.8233	-0.706	0.9992
0.257333333	193	0.75	0.819	-0.833	0.9974
0.174444444	157	0.9	0.7813	-0.7539	0.9966

Figure 11a Optimized Quadrapole Illumination NA Center vs. Focus for Fixed Pole Radius and NA Exit =0.6

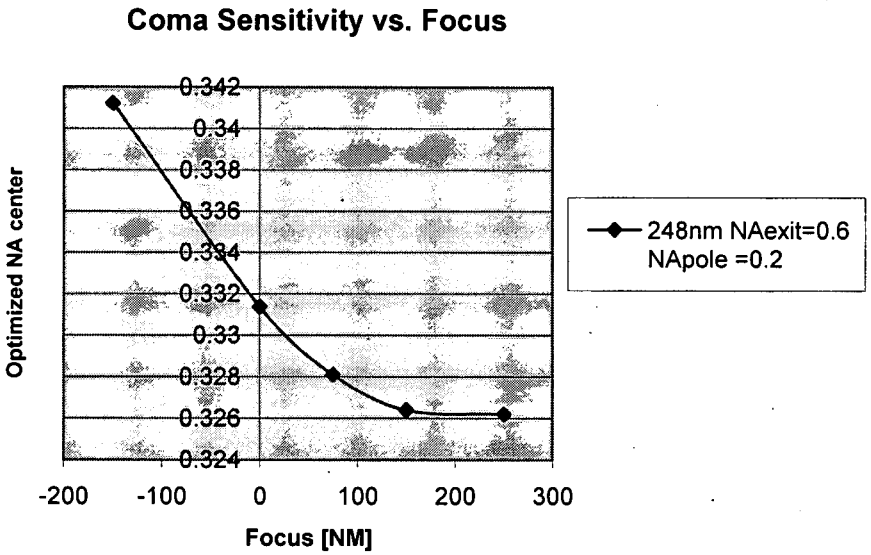
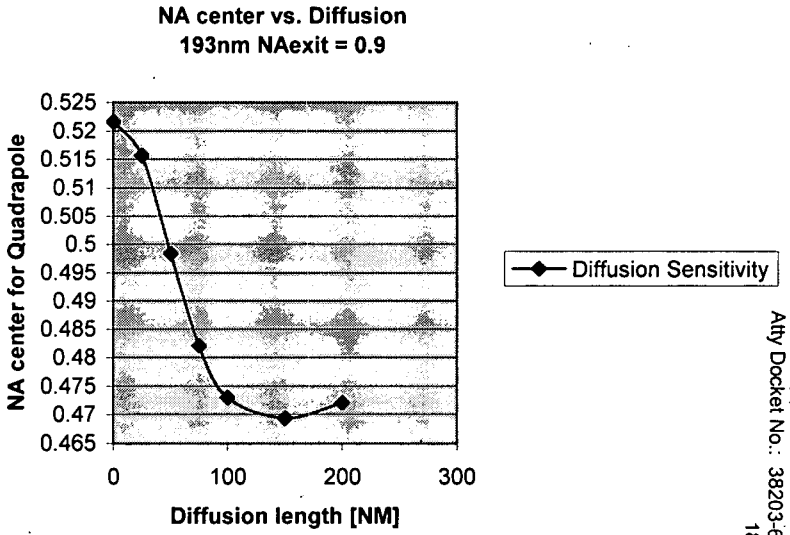


Figure 11b Optimized Quadrapole Illumination NA Center vs. Transverse Diffusion



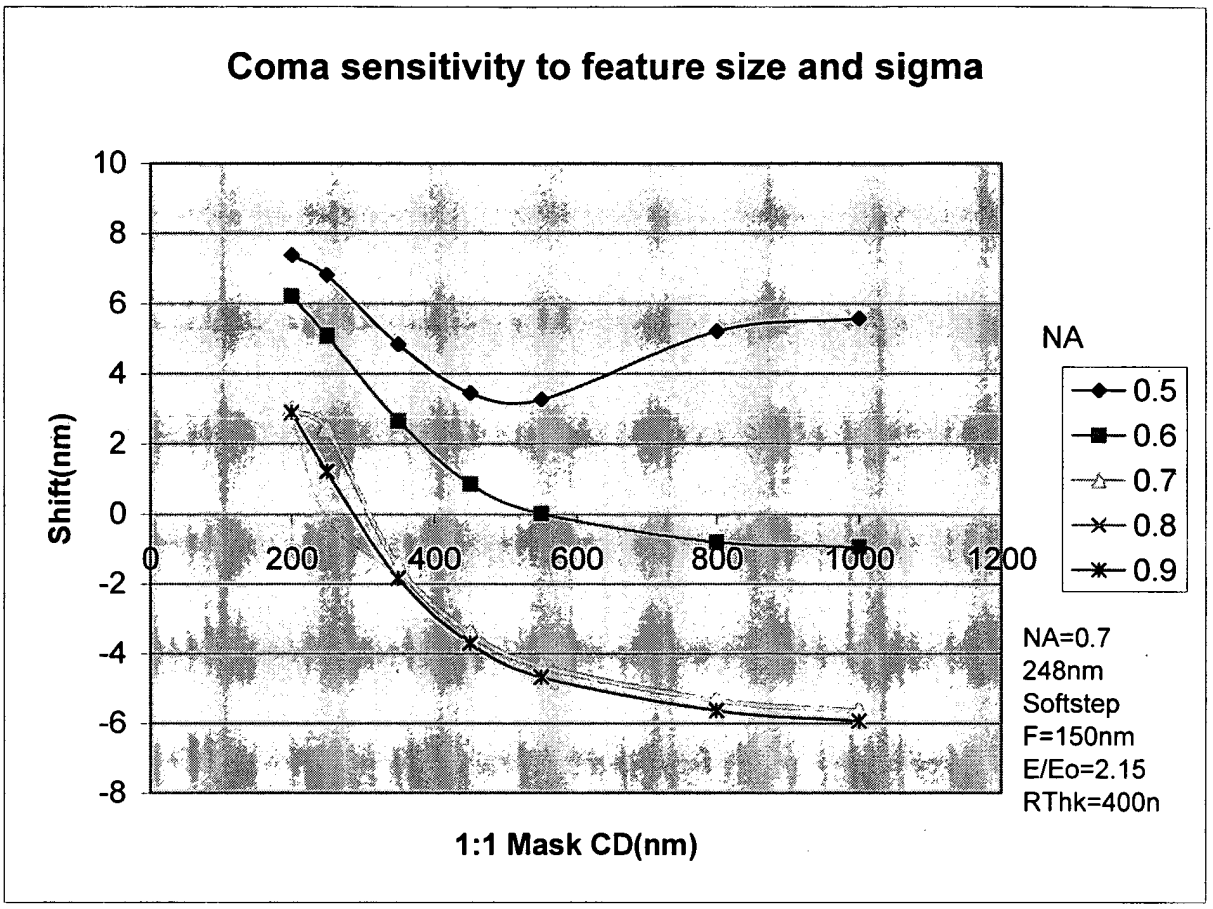


Figure 12 Coma Shift Sensitivity for Equal Line and Space Features. Curves Labeled by Conventional Source Numerical Aperture (Na_s or NA source).

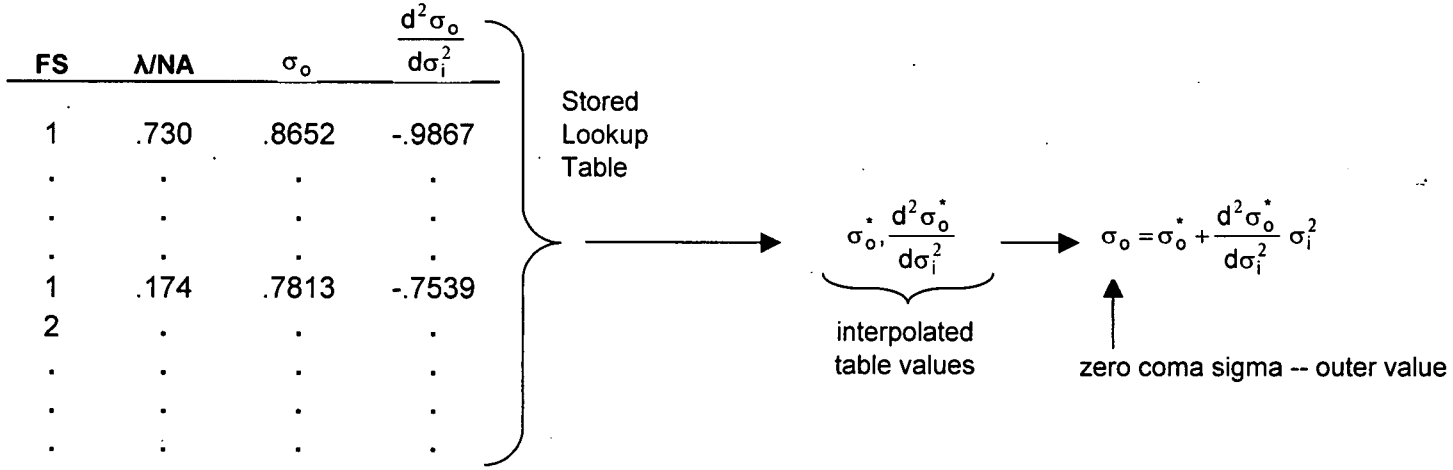


Figure 13 Stored Lookup Table and use for Determining Zero Coma Illumination Condition for Conventional or Annular Illumination.

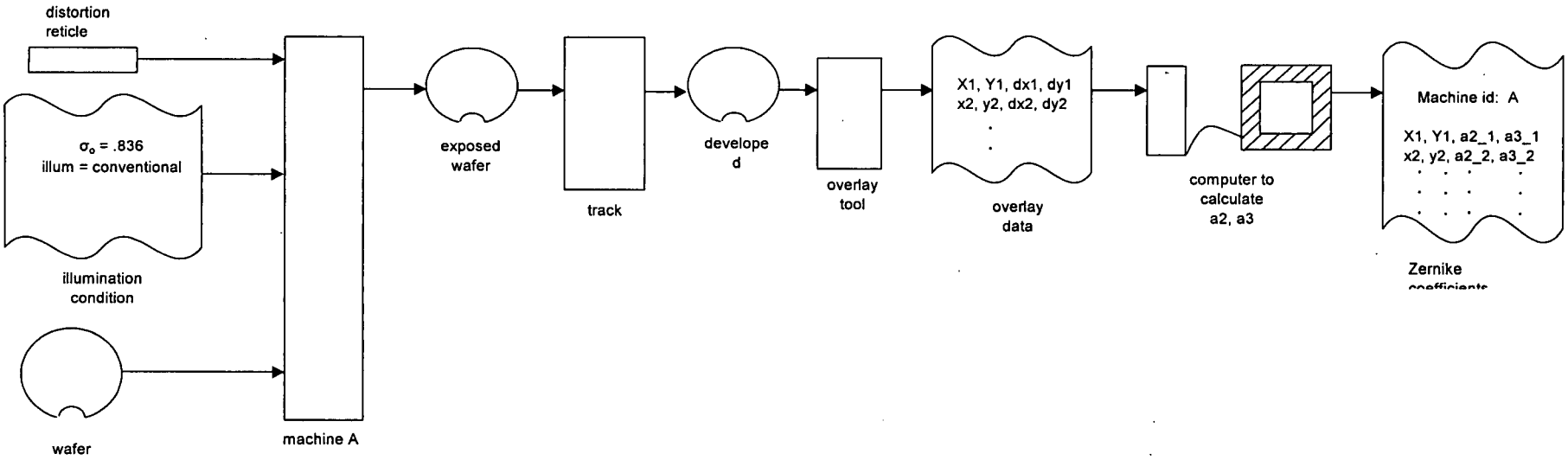


Figure 14 Schematic of Application of the Method of this Invention to Determining a2, a3 in a Lithographic Projection Tool.

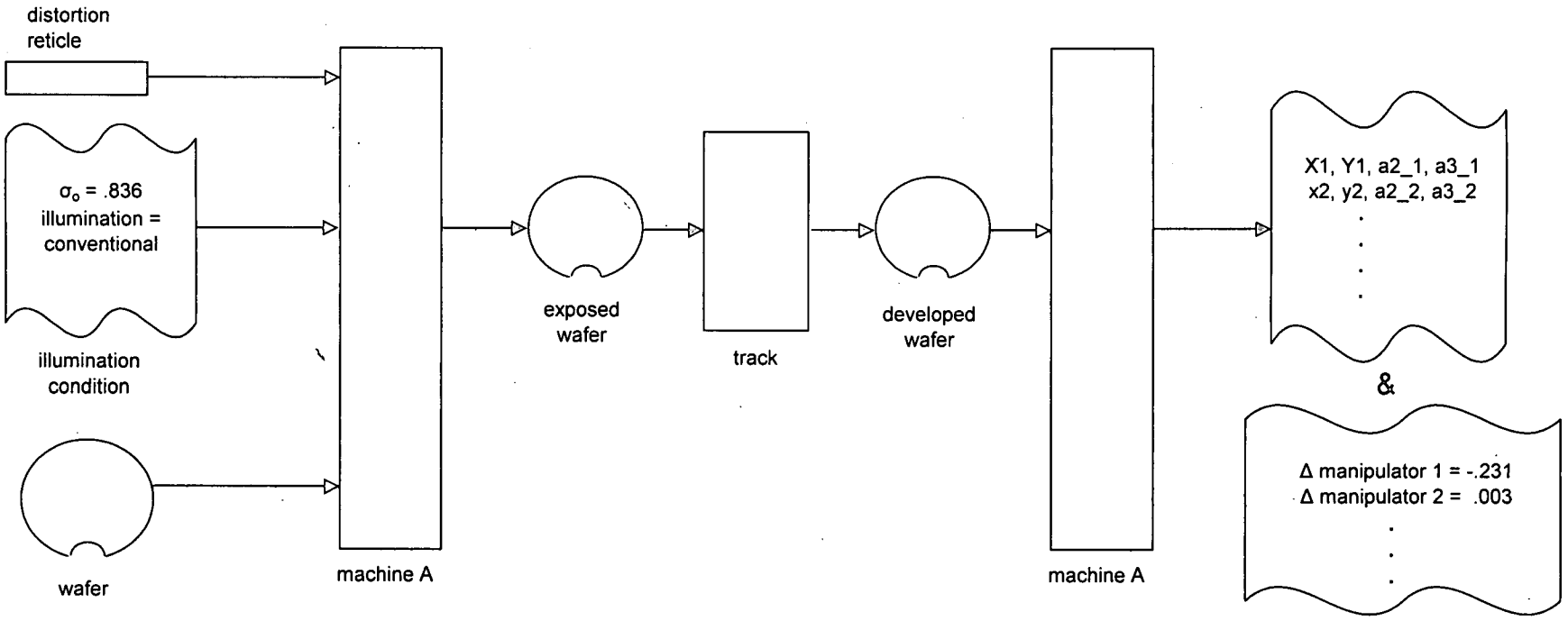


Figure 15 Schematic of Application of the Method of this Invention to Machine Self Determination and Correction of Transverse Distortion.

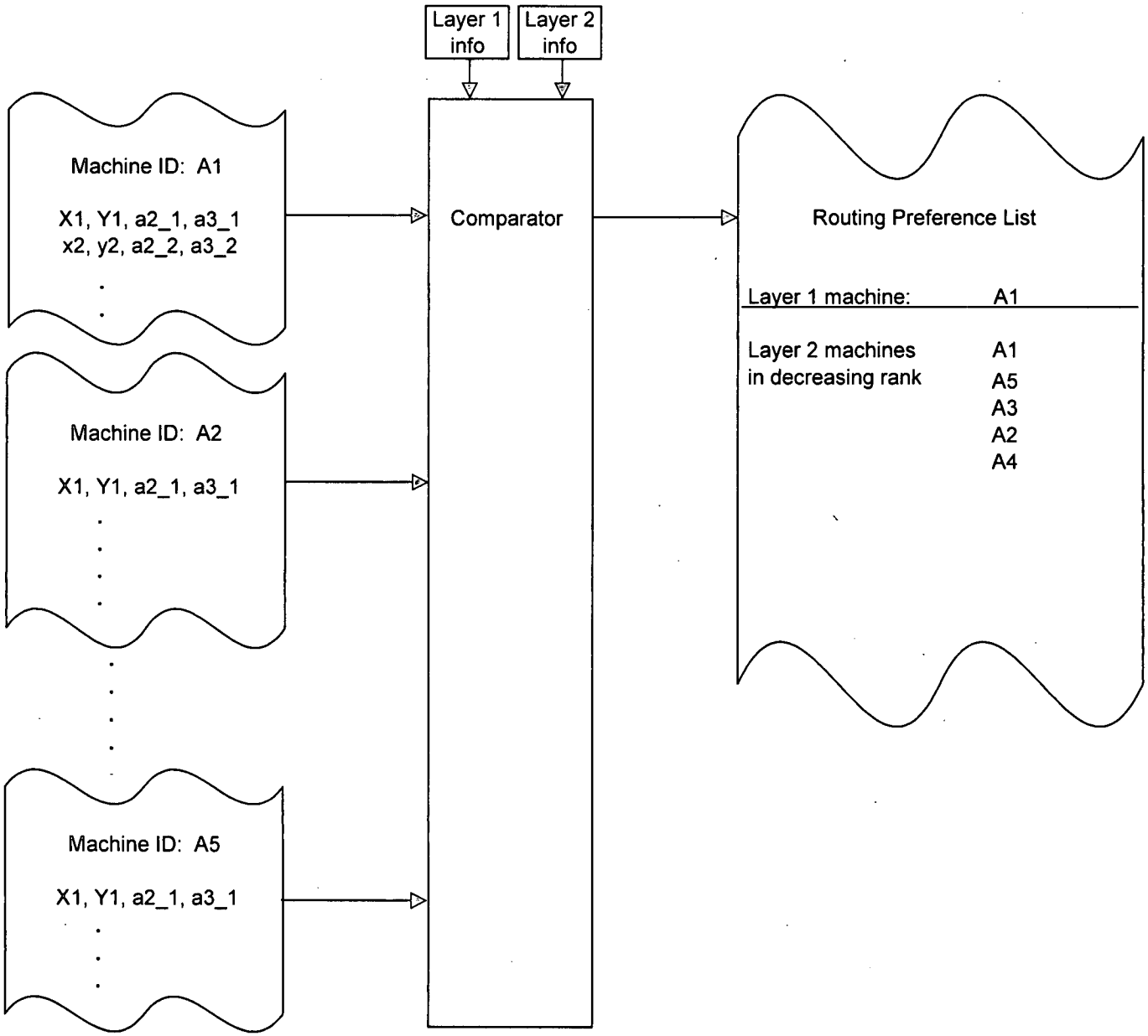


Figure 16 Schematic of Application of the Results of this Invention to Routing Product in a Chip Fab.